Republic of South Africa

EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.

SANS 1307 (2009) (English): Domestic storage solar water heating systems

BLANK PAGE

Edition 4

SWAZILAND NATIONAL STANDARD

Domestic solar water

Published by: Swaziland Standards Authority
Smithco Building, 2nd Floor, Conco Road
P. O. Box 1399, Matsapha, Kingdom of Swaziland
Telephone: +268 2518 4633, Facsimile: +268 2518 4526
Website: www.swasa.co.sz
E-mail: info@swasa.co.sz

Table of changes

Clause Changed	Date	Change

NATIONAL FOREWORD

This Swaziland National Public Review Draft Standard was prepared by Technical committee *SWASA/TC 33 Solar and Electrical* in accordance with procedures of the Swaziland Standards Authority, in compliance with Annex 3 of the WTO/TBT Agreement. This national public review draft standard is the identical implementation of SANS 1307:2009 and is adopted with the permission of the South African Bureau of Standards (SABS).

ISBN 978-0-626-21251-3

SANS 1307:2009

Edition 4

SOUTH AFRICAN NATIONAL STANDARD

Domestic solar water heaters

Published by SABS Standards Division
1 Dr Lategan Road Groenkloof ✉ Private Bag X191 Pretoria 0001
Tel: +27 12 428 7911 Fax: +27 12 344 1568
www.sabs.co.za

SANS 1307:2009
Edition 4

Table of changes

Change No.	Date	Scope

Foreword

This South African standard was approved by National Committee SABS TC 1057, *Solar heating systems*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in January 2009. This document supersedes SANS 1307:2007 (edition 3.3).

Annexes A and D form an integral part of this document. Annexes B, C and E are for information only.

Contents

This page is intentionally left blank

Domestic solar water heaters

1 Scope

1.1 This standard specifies the requirements of domestic solar water heating systems.

1.2 The standard is not applicable to solar water heaters for swimming pools or to industrial and commercial solar water heaters, or to push-through type domestic solar water heaters.

2 Normative references

The following referenced documents are indispensible for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ASTM A 167, *Standard specification for stainless and heat-resisting chromium-nickel steel plate, sheet, and strip.*

ASTM A 240, *Standard specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for pressure vessels and for general applications.*

EN 573-3, *Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products.*

SANS 135/ISO 1456, *Metallic coatings – Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium*.

SANS 141, *Glass-reinforced polyester (GRP) laminates.*

SANS 151, *Fixed electric storage water heaters.*

SANS 200, *Copper alloy ingots and castings.*

SANS 460, *Plain-ended solid drawn copper tubes for potable water*.

SANS 999, *Anodized coatings on aluminium (for architectural applications).*

SANS 1034, *Grey iron castings.*

SANS 1190 (SABS 1190), *Malleable iron castings.*

SANS 2063/ISO 2063, *Thermal spraying – Metallic and other inorganic coatings – Zinc, aluminium and their alloys*.

SANS 6210 (SABS SM 1210), *Domestic solar water heaters – Mechanical qualification tests.*

SANS 6211-1, *Domestic solar water heaters – Part 1: Thermal performance using an outdoor test method.*

SANS 6211-2, *Domestic solar water heaters – Part 2: Thermal performance using an indoor test method.*

SANS 9933/ISO 9933, *Products in fibre-reinforced cement – Long corrugated or asymetrical section sheets and fittings for roofing and cladding.*

SANS 10106, *The installation, maintenance, repair and replacement of domestic solar water heating systems.*

SANS 10137 (SABS 0137), *The installation of glazing in buildings.*

SANS 10142-1, *The wiring of premises – Part 1: Low-voltage installations*.

SANS 10252-1, *Water supply and drainage for buildings – Part 1: Water supply installations for buildings.*

SANS 10254, *The installation, maintenance, replacement and repair of fixed electric storage water heating systems.*

SANS 10400 (SABS 0400), *The application of the National Building Regulations.*

SANS 51706/EN 1706, *Aluminium and aluminium alloys – Castings – Chemical composition and mechanical properties*.

SANS 60335-2-21 (SABS 60335-2-21), *Household and similar electrical appliances – Safety Part 2-21: Particular requirements for storage water heaters.*

3 Definitions

For the purposes of this document, the following definitions apply.

3.1
absorber
part of a solar heating collector that receives radiant energy and transforms it into thermal energy which is used to heat the heat-transfer fluid passing through the collector or to heat the water directly

3.2
acceptable
acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

3.3
aperture
area in a collector cover through which unconcentrated solar radiant energy is admitted to the absorber

3.4
collector
device that contains or incorporates an absorber and a means for transferring thermal energy from the absorber to a fluid passing through the collector

3.5
collector cover
transparent or translucent material that covers the aperture and provides thermal retention and environmental protection of the unit and may include a hail cover

3.6
daily heat output
energy output above mean inlet temperature of a collector ($Ta - Tc = 10\ K$) as determined by the full day heating test, and normalized to a base of 20 MJ/ m^2/d of solar energy input

3.7
direct heating system
heating system in which the potable water to be heated is circulated through the absorber, and the solar heat gathered by the collector is transferred directly to the potable water itself

3.8
fluid channels
channels in solar water heater systems through which heat transfer fluid flows

3.9
hail cover
a cover for collector other than glazing that will prevent hail impact damage

3.10
heat exchanger
device specifically designed to transfer heat between two physically separated fluids

3.11
heat transfer fluid
medium, such as air, water or other fluid, that passes through a collector and carries absorbed thermal energy from the collector to the potable water to be heated

3.12
indirect heating system
system in which an absorber transfers heat via a heat exchanger to the potable water to be heated

3.13
preheater
solar heater installed in series between the pressure control valve and the primary water heater

3.14
separate storage system
split system
system in which the hot water storage container is remote from the collector(s)

3.15
solar water heater
complete operating system that uses energy from the sun to produce hot water and comprises one or more collectors, one or more hot water storage tanks whether supported by supplementary energy sources or not, and all necessary interconnecting pipes and functional components

3.16
supplementary energy sources
auxiliary heating source independent of solar thermal radiation

4 Requirements

4.1 Types

A solar water heating system shall be one of the following, as required (see annex A).

Table 1 — SWH system options

1	2	3	4	5	6	7	8	9
Collector/Storage Combinations								
integral	close-coupled				split			
Heat transfer method								
direct	direct		indirect		direct		indirect	
Circulation method								
thermo-siphon	thermo-siphon	pumped	thermo-siphon	pumped	thermo-siphon	pumped	thermo-siphon	pumped
NOTE 1 Any of the above may be with or without auxiliary (back-up) power supply i.e. electric or gas.								
NOTE 2 Pumped (forced) circulation can be achieved with electrical mains or photovoltaic powered pumps.								

4.2 Heating system

The heating system shall be direct or indirect, and with or without supplementary energy sources as required (see annex A).

4.3 Operating system

The operating system shall be as required (see annex A), and shall consist of:

a) an integral system, in which the hot water storage tank is incorporated integrally with the collector and is stored in the body of the collector;

b) a close-coupled system, in which hot water is stored in a separate but close-coupled water storage tank (see 4.4);

c) a separate storage system (split system), in which hot water is stored in a water storage tank (see 4.4) that is separate from the collector; or

d) a pre-heater system, in which a solar water heater does not contain a means of supplementary heating and is installed to preheat the cold potable water supply prior to its entry into any other type of household water heater.

4.4 Hot Water storage tank

A hot water storage tank (with or without supplementary heating) shall comply fully with the relevant mechanical and design requirements of SANS 151 and with all the additional requirements for solar storage water heaters given in SANS 151 and with the additional requirements given in 4.11.1.2.

4.5 Collector cover

The collector shall be designed to operate with or without a collector cover, as required (see annex A). If a hail cover is used it should be non-corrosive, easily removable for cleaning and shall not impair the operation of the system. If constructed in solid sheet form it shall be secured so as to resist an upward force of not less than 200 N.

4.6 Thermal insulation

Thermal insulating material used in the construction of the collector and interconnecting pipes shall be of such quality and composition and so applied that

a) it does not unduly compress after installation,

b) when in contact with a metal, it does not cause corrosion of the metal,

c) it does not react in the presence of heat in a manner that will produce corrosive salts or vapours, and

d) it is dimensionally stable under dry conditions at the maximum expected temperatures likely to be reached in the collector or when exposed to the effects of UV radiation.

4.7 Galvanic action

Where different materials are joined together or coupled in the same system, acceptable precautions shall be taken in respect of the choice of materials, the method of jointing and the use of inhibitors, in order to reduce the possibility of galvanic action under wet and dry conditions.

4.8 Construction

4.8.1 General

All components of a solar water heater shall be of sturdy and acceptable design and construction. The parts and the assembled unit shall have a neat workman-like appearance.

4.8.2 Joints

Joints between components shall be of acceptable design and quality and shall not leak and shall comply with the relevant SANS standard. Where required, adaptors to suit South African pipe and fitting standards shall be provided.

4.9 Stagnation requirements for collector and connecting pipework

The construction of a solar water heater and the quality of the different materials used shall be such that, when the solar water heater is tested in accordance with 5.2, any

a) deformation of any part of the collector,

b) vapour deposition on the underside of the collector cover,

c) degrading of paint, sealants, seals or insulation, and

d) cracking, flaking, blistering or loss of cohesion of the absorber paint film,

will not be of such magnitude as to impair the operation of the solar water heater.

4.10 Working pressure

A solar water heater shall be designed for a working pressure of zero (open type system), 100 kPa, 200 kPa, 300 kPa 400 kPa or 600 kpa, as required. The design and construction of any component or system shall be such that, when the component or system is tested in accordance with 5.3, there is no failure that could affect the acceptable operation of the component or system.

4.11 Structural protection

4.11.1 Resistance to rain penetration

4.11.1.1 Collector

When the collector of a solar heater is tested in accordance with 5.4, the interior of the collector shall remain free from any water.

4.11.1.2 Hot water storage tank

A hot water storage tank that is intended to be installed on the outside of a building shall be effectively protected, by means of a corrosion resistant outer casing, against the effects of rain, wind and other elements. Seams on the outer casing and the entry holes for pipe connections shall be effectively sealed to make a permanent watertight closure. All exposed piping or fittings (or both) which form part of the storage tank, shall be of a non-corrosive material or protected against corrosion.

4.11.2 Resistance to hail

The collector cover of a solar water heater shall be of such quality and strength that, when it is tested in accordance with 5.5, it does not suffer any damage that could impair its normal operation.

4.11.3 Resistance to freezing

A solar water heating system that is marked as resistant to freezing (see 6.1(f)) shall, when tested in accordance with 5.6, show no sign of any damage that could impair its normal operation. Failure of potable water inlet and outlet pipe work connections are not considered to be a system failure.

4.11.4 Resistance to fatigue and hydrostatic pressure

When a solar water heater is tested in accordance with 5.3, there shall be no leakage or any sign of damage or deformation that could impair the normal operation of any of its components.

4.11.5 Resistance to physical damage

The major components of the solar water heater shall be so designed, constructed and, when relevant, protected as to ensure that the components will remain in an acceptable condition after handling, transport and installation.

4.11.6 Safety requirements for hot water storage tanks

The hot water storage tanks of all solar water heaters shall comply with the safety requirements specified in SANS 60335-2-21. All solar water heater systems with provision for supplementary heating shall be tested with such supplementary energy operational.

4.12 Materials

4.12.1 General

Except where already specified in applicable standards, the materials and, when relevant, their surface protection and its method of application, shall be such that they will perform their respective functions in a durable manner.

NOTE 1 ISO/TR 10217 gives a brief introduction to the corrosion risks of various material/fluid combinations.

NOTE 2 See also annex B for information on factors governing corrosion and internal scaling of solar water heating systems.

NOTE 3 For information on chloride content of water supplied to certain South African urban areas, see annex C.

4.12.2 Aluminium

An aluminium alloy that complies with the relevant SANS standard.

4.12.3 Copper

4.12.3.1 Copper tubing shall comply with the relevant requirements of SANS 460 where in contact with potable water and connected to a water supply in compliance with SANS 10252-1.

4.12.3.2 Brass castings shall comply with the requirements for Cu-Zn alloys of SANS 200. If the alloy is in direct contact with the main water supply, it shall, when a specimen is tested for dezincification in accordance with 5.7, show a depth of penetration not exceeding 250 µm.

4.12.4 Stainless steel

Stainless steel

a) for general mechanical construction shall be one of the types given in ASTM A 167 or ASTM A 240, and

b) for fluid channels shall be one of the types given in ASTM A 240.

4.12.5 Polymeric materials

4.12.5.1 Glass-reinforced polyester (GRP)

GRP shall comply with the relevant requirements for type S of SANS 141.

4.12.5.2 Other components (including fluid channels)

Each polymeric material shall be one that is capable of performing the required function and that

a) is based on a polymer of grade and quality recommended by the polymer manufacturer as being suitable for the function it has to perform,

NOTE The polymer manufacturer should be advised if there is a possibility that the material could be used in contact with copper or could be required to operate at temperatures in excess of 100 °C.

b) for fluid channels, contains no reground material,

c) for components other than fluid channels, contains no reground material in excess of 10 % by mass where any reground material present is clear reworked material derived from the manufacturer's own production, and

d) has not deteriorated during compounding and production.

Polymeric material shall have been acceptably heat-stabilized and protected from the effects of ultraviolet light by incorporation of acceptable UV stabilizer(s) in appropriate quantities.

4.12.6 Fibre cement

The composition of fibre cement shall be as given in SANS 9933.

4.12.7 Glass-reinforced cement (GRC)

GRC shall consist of an acceptable mixture of cement and alkali-resistant glass fibre and shall be of a quality recommended by the supplier as suitable for the particular duty for which it is intended.

4.12.8 Sealants

Sealant material shall be suitable for its intended purpose.

Sealant shall have been applied in accordance with the relevant recommendations of SANS 10137. No sealant shall be such that it will develop, or cause the development of corrosive salts or vapours.

4.12.9 Water absorption of composite and polymeric material not in contact with transfer fluid

The water absorption of a composite or a polymeric material shall, when a specimen is tested in accordance with 5.8, not exceed 0,5 %.

4.12.10 Heat transfer fluid

The heat transfer fluid used in an indirect heating system shall be non-toxic and non-corrosive.

Heat transfer fluids should also have a colour added in order to detect a rupture between close and open circuits if it happens.

4.13 Thermal properties

4.13.1 Thermal performance

When the thermal performance of a solar water heater is evaluated in accordance with 5.10, the daily heat output shall not be less than 9 $MJ/m^2/d$.

4.13.2 Standing loss

When the standing loss of a solar water heater is determined in accordance with 5.10, the overnight heat loss shall be as described in SANS 151.

4.13.3 Mixing factor

When the mixing factor of a solar water heater is evaluated in accordance with 5.10, the hot water output shall be as described in SANS 151.

4.14 Corrosion protection

4.14.1 General

All materials, including surface protection materials, that are intended to be in contact with potable water, shall be non-toxic, shall not cause the water to become toxic, and shall not impart any colour or objectionable odour to the water. The material(s) for waterways shall be intrinsically corrosion resistant.

4.14.2 Corrosion resistance of external surfaces of components

The material of the component or quality and method of application of surface protection coatings (except surface coatings of absorber surfaces), as relevant, shall be such that, when any metallic component of a solar water heater is tested in accordance with 5.9, there is no visible sign of corrosion of the basic material or penetration of the surface coating.

4.14.3 Electroplated coatings

Electroplated coatings shall comply with at least the requirements of SANS135 where applicable.

4.14.4 Thermal-sprayed metal coatings

Thermal-sprayed metal coatings shall comply with the requirements of SANS 2063.

4.14.5 Anodizing

Anodizing shall comply with at least the requirements for a coating of grade AA20 of SANS 999.

5 Methods of test

NOTE For more information on quality verification of solar water heaters, see annex D.

5.1 Sequence of tests

Carry out the tests given in 5.2 to 5.10, (inclusive) in the sequence given, one immediately after the other .

5.2 Stagnation test for collector

Carry out the test given in SANS 6210 and check for compliance with 4.9.

5.3 Mechanical strength

Carry out the test given in SANS 6210 and check for compliance with 4.10 and 4.11.4.

5.4 Resistance to rain penetration

Carry out the test given in SANS 6210 and check for compliance with 4.11.1.1.

5.5 Resistance to hail

Carry out the test given in SANS 6210 and check for compliance with 4.11.2.

5.6 Resistance to freezing

Carry out the test given in SANS 6210 and check for compliance with 4.11.3.

5.7 Dezincification resistance

Carry out the test given in SANS 6210 and check for compliance with 4.12.5.2.

5.8 Water absorption of composite and polymeric material

Carry out the test given in SANS 6210 and check for compliance with 4.12.9.

5.9 Corrosion resistance

Carry out the test given in SANS 6210 and check for compliance with 4.14.2.

5.10 Thermal properties

Carry out the test given in SANS 6211-1 or SANS 6211-2 and check for compliance with 4.13.

6 Marking and method of marking

6.1 Marking

Each hot water storage tank shall be marked according to SANS 151 and all collectors shall be legibly and indelibly marked with the following information:

a) the manufacturer's name, trade name or trade mark;

b) the working pressure (see 4.10);

c) a model number;

d) the aperture area;

e) whether fitted with hail cover or not;

f) whether resistant to freezing or not;

g) the material of the fluid channels;

h) the material of the collector cover;

i) the type, mixing ratio and grade of transfer fluid (for indirect systems);

j) the total and useful energy rating, in kilo Watt hours per square metre per day; and

k) date of manufacture and or serial number.

6.2 Method of marking

The information required in 6.1(a) to 6.1(k) (inclusive) shall be stamped or embossed on the collector or on a nameplate securely attached to the collector. In addition, the information required in 6.1(f) shall be given (in letters of height at least 30 mm) on a removable sticker fixed to the glazing of the collector. (Instead of the removable sticker consider a tag for evacuated tubes.)

6.3 Instruction booklet

A booklet or leaflet in English shall be attached to each solar water heater and shall set out the following:

a) information regarding the thermal properties of the solar water heater (see SANS 6211- 1 and SANS 6211-2);

b) instructions for the safe and correct installation of the complete solar water heater, with a description of all operating components and instructions for regular maintenance, including, when relevant, the maintenance of any sacrificial anode;

c) clear and unambiguous advice regarding resistance to freezing and hail (see 6.1(f));

d) safety precautions; and

e) precautions regarding corrosion prevention and warning details are given in annex B.

The information contained on the marking label shall be included in the booklet (see 6.1 and SANS 151).

Annex A
(normative)

Notes to purchasers

The following requirements shall be specified in tender invitations and in each order or contract:

a) the type of solar water heater (see 4.1);

b) the type of heating system (see 4.2);

c) the type of operating system (see 4.3);

d) whether the collector is to be designed to operate with or without a cover (see 4.5);

e) the working pressure (see 4.10) for both primary and secondary circuits;

f) whether the solar heater is hail resistant (see 4.11.2); and

g) whether it has a supplementary energy source or not (see 4.2).

Annex B
(informative)

Factors governing corrosion and internal scaling of solar water heating systems[1)]

B.1 The tendency for metal corrosion or scaling to occur in a solar water heating system will depend on the characteristics of the water in the system. The evaluation given in annexes B.2 to B.4 may be included to aid in developing an acceptable corrosion prevention procedure.

B.2 A full water analysis should be carried out and the Langelier Saturation Index and the Ryznar Stability Index calculated to give a guide as to the expected scaling/corrosion tendency of the water.

B.3 The known performance of metals in a particular water should be ascertained from local user and supplier experience and checked against the likely performance as predicted from chemical analysis of the water. It should always be remembered, however, that design factors (open circuit, closed circuit, material choice, crevices, etc.) may override factors predicted from water chemistry or from the corrosion history.

B.4 In water with a high chloride or a high sulphate content, predictions calculated from a chemical analysis of the water should be treated with caution. It is difficult to define what a high chloride content is since this could vary from water to water and from metal to metal. The hardness of the water could be an important factor in terms of the chloride tolerance of a metal (see annex C).

1) Callaghan, B G. *Corrosion of solar water heating systems.* British Corrosion Journal, Vol. 14, No. 2, 1979, p. 78.

Annex C
(informative)

Chloride content of water supplied to certain South African urban areas

It should be emphasized that the figures given in table C.1 should not be regarded as representative of the water generally supplied to cities and towns. The chloride content of the water supplied in localities other than those listed could be of an entirely different order.

Table C.1 — Chloride content of water

1	2	3	4	5
Item	**Source**	**Chloride** mg/L		
		Min.	**Max.**	**Average**
	Rand Water Board			
1	Zuikerbosch pump station	7	14	10
2	Vereeniging pump station	16	89	34
	Pretoria			
3	Fountains	–	–	3
4	Rietvlei	–	–	6
5	Sterkfontein	–	–	2
	Cape Town			
6	Voëlvlei (approximately)	40	80	60
7	Wemmershoek	7	13	11
8	Steenbras	18	24	21
9	Port Elizabeth	61	64	61
10	East London	–	–	61
	Durban			
11	Umgeni	–	–	10
12	Umlaas	–	–	54
	Windhoek			
13	Swakopdam	–	–	11
14	Goreangap	–	–	16
15	Reclaimed sewage effluent	–	–	183
16	Bloemfontein	–	–	10
17	Empangeni (KwaZulu-Natal)	–	–	120
NOTE The chloride content of the water supplied to customers in cities and towns varies, depending on the source of the water and the time of the year.				

Water obtained from certain boreholes could have a very high chloride content.

Before systems that include stainless steel or aluminium components are installed, it is recommended that the borehole water should first be analysed to determine its suitability for use with such components.

Annex D
(normative)

Installations, replacement and retrofit

D.1 Solar water heating installations shall comply to the following installation codes as applicable, SANS 10106, SANS 10254, SANS 10252-1, SANS 10400 and SANS 10142-1.

D.2 For a new installation where there is no pre-existing hot water installation, any of the options in table 1 could be suitable.

D.3 For replacement, in which the existing hot water installation is removed and replaced with a solar water heating system, any of the options in table 1 could be suitable.

D.4 Retrofit installations onto existing electrical hot water installations can be either a solar pre-heater retrofit option (a) or a circulating retrofit option (b).

a) A solar pre-heater retrofit option, where there will be no continual circulation of heated potable water between the solar water heater storage tank and pre-existing electrical storage water heater. The cold inlet to the solar pre-heater is connected downstream of the existing pressure control valve, and the hot outlet of the solar pre-heater is connected to the inlet connection of the existing electrical storage water heater, not into its hot outlet pipe. Flow of solar heated water to the pre-existing electrical water heater only occurs when hot water is drawn off at terminal fittings. This option may negatively affect flow pressure performance at terminal fittings due to the additional in-line friction pressure losses.

b) A solar circulating retrofit option or any appropriate system in table 1 may be used. The circulating potable water between the solar water heater and the existing storage water heater must be connected so that the heated water is circulated between the retrofitted solar water heater and the existing electrical storage water heater.

D.5 In both the (a) and (b) options the hot water supply or circulating pipes from the solar water heater may not be connected to the hot outlet pipe of the existing electrical storage water heater. The pressure rating of the solar water heating system shall be matched to that of the existing electrical storage water heater.

Annex E
(informative)

Quality verification of solar water heaters

When a purchaser requires ongoing verification of the quality of solar water heaters, it is suggested that instead of concentrating solely on evaluation of the final product, he also direct his attention to the manufacturer's quality system. In this connection it should be noted that SANS 9001 covers the provision of an integrated quality system.

Bibliography

Standards

ISO/TR 10217, *Solar energy – Water heating systems – Guide to material selection with regard to internal corrosion.*

SANS 9001/ISO 9001, *Quality management systems – Requirements*.

Other publications

Callaghan, B G. *Corrosion of solar water heating systems*. British Corrosion Journal, Vol. 14, No. 2, 1979, p. 78.

This page has been left blank intentionally